

Contents

Introduction	i
Personnel	ii
Publications and Reports	iv
Research Projects	
I. Microwave and Physical Electronics	1
A. High-Power Magnetron Research	1
B. Cathode Research	7
1. Conductivity and Work Functions of Oxide Cathodes	7
2. Spectral Emissivity of Tungsten	7
3. Electron Emission in Accelerating and Retarding Fields	9
C. Ionization Gauge Research	9
D. Properties of Cathode-Ray Tube Screens	10
E. Determination of Emission Properties of Single Crystals	10
F. Traveling-Wave Amplifier Tubes	10
II. Microwave Physics	11
A. Microwave Spectroscopy	11
1. Microwave-Frequency Bridge	11
2. Sweep Spectrometer	11
3. Miscellaneous Problems	12
B. Molecular Beam Research	13
1. Hyperfine Structure of K^{40}	13
2. Hyperfine Structure of Chlorine	16
3. Hyperfine Structure of Na^{22}	17
4. Electron Multiplier	17
5. Hyperfine Structure of Hydrogen	19
6. Third Molecular Beam Apparatus	19
7. Nuclear Quadrupole Effects in the Molecular Beam Spectra	20
C. Low-Pressure Gas Discharges	21
D. Low-Temperature Research	28
1. Helium Liquefiers	28
2. Superconductivity at Microwave Frequencies	28
3. Resistivity of Normal Conductors	28
4. Adiabatic Demagnetization	31
5. Classification of Phase Transitions	32
E. Magnetic Nuclear Resonance Experiments	32
F. Paramagnetic and Ferromagnetic Resonance Absorption at Microwave Frequencies	35
III. Modern Electronic Techniques Applied to Physics and Engineering	37
A. Design and Construction of a Microwave Accelerator	37
B. Ultrasonics Research Program	38
1. Mechanical Excitation of Second Sound in Liquid Helium II.	38
2. Low-Temperature Velocity Measurements of Second Sound.	
3. High-Frequency Ultrasonics	38
4. Ultrasonic Absorption in High Polymers	39
C. Development of Flash Tubes	40

IV.	Communications and Related Projects	47
	A. Pulse Modulation Studies	49
	B. Stabilized Oscillator Problems	50
	C. Multipath Transmission	50
	D. Properties of Random Noise	51
	1. Statistical Properties	51
	2. Effect of Transit Time on Shot Noise	52
	E. Synthesis of Optimum Linear Systems	52
	1. Optimum Filtering	52
	2. Optimum Prediction	52
	F. Response of Networks to Frequency Transients	53
V.	Miscellaneous Problems	54
	A. Electronic Differential Analyzer	54
	B. Mathematical Instrumentation	57
	C. Locking Phenomena in Microwave Oscillators	59
	D. Electronic Potential Mapping	59
	E. Investigation of Electroencephalic Activity over a Wide Frequency Band	59
	F. Physical Limitations of R-F Radiating Systems	60
	G. Transmission Problems for Millimeter Waves	61
	H. The Scattering of Electromagnetic Waves; Matrix Methods	62
	I. Active Networks	62
	J. Transient Phenomena in Waveguides	63
	K. Mathematical Problems	63